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## THE ADJUSTMENT OF WAGES TO EFFICIENCY

### THREE PAPERS

ON

GAIN-SHARING

THE PREMIUM PLAN

A PIECE RATE SYSTEM

BY

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# THE ADJUSTMENT OF WAGES TO EFFICIENCY

# NOTE.

THE three papers here reprinted were read before the American Society of Mechanical Engineers, at the meetings of 1889, 1891, and 1895. Though printed in the Proceedings of that Society for the years mentioned, they are not easily accessible to economic students. The accounts which they give of the various methods by which it has been attempted to adjust wages to efficiency, and to devise methods of payment which shall secure the advantages of piece-work and of profit-sharing, are of interest and of importance, and the Publication Committee of the Economic Association believes that a service will be done to members of the Association and to the public by adding them to the *Studies*. They are republished with the kind permission of the authors and of the Society of Mechanical Engineers.

# GAIN-SHARING.

BY HENRY R. TOWNE.

Webster defines *profit* as *the excess of value over cost*, and *gain* as meaning *that which is obtained as an advantage*. I have availed of this well-expressed though delicate distinction between the two terms, to coin a a name for the system herein described, whereby to differentiate it from profit-sharing as ordinarily understood and practiced.

Profit-sharing, as the term is now commonly used, implies a voluntary agreement, on the part of the principal in business, to set aside some portion of the profits of his business for division among all or certain of his employees, as a stimulus to their zeal and industry. Thus understood, profit-sharing involves the participation of the employee in all the complex factors that affect the final result, or profit, of a business, including necessarily its *losses*, since these tend to impair, or may even extinguish, the profit. He thus becomes practically a partner, except that his participation in losses is limited to the surrender of his share in anticipated profits, and does not involve any impairment of his personal capital.

It follows, therefore, in most cases of profit-sharing, that the interest of each participator in the profit fund is largely affected by the actions of others whom he cannot control or influence, and that what he may earn

or save for the common good may be lost by the mismanagement or extravagance of others. For example, let us suppose the case of a trader who buys and sells a certain staple, such as cotton, and who, having two clerks, entrusts to one of them the purchasing of the staple, and to the other the business of selling it to the customers of the house. Obviously here the amount of profit will depend partly upon the ability of the buyer to purchase material of the proper quality at the lowest market rate, and partly upon the ability of the seller to dispose of it promptly at the highest obtainable prices. If each does his share well, a large profit may result; while if either fails in his part there may be no profit, and even a loss, no matter how well the other may have performed his part. But it does not follow that the work of either or both will determine the question of profit, for unexpected changes in the market may neutralize the best plans and cause loss, or may result in large profit in spite of unskilful management.

Let us now suppose the case of a manufacturer who, in addition to buying the raw material, converts it into a finished product before selling it, and who voluntarily concedes to the operatives of the manufacturing department of his business, as well as to his chief assistants, a participation in its profits. The factors affecting the profit fund now become more complex, and may be divided into several distinct groups, as follows:

1. Those contributed or controlled by the owner or principal,—such as capital, plant, character of buildings, machinery and organization; and, to a greater or less

degree, the skill, experience, industry, and ability of the owner so far as he personally manages the business.

2. Those influenced by the mercantile staff,—the buyer and the selling agent in the case supposed.

3. Those determined by causes beyond the control of the principal and his agents; such as fluctuations in cost of raw material or in the market value of the finished product, the rate of interest, losses by bad debts, etc.

4. Those influenced by the workmen or operatives; such as care of property, economy in the use of material and supplies, and, chiefly, efficiency in the use of machinery and employment of labor.

Now it is obvious that while the operatives may influence the items in the fourth or last group to an extent which may be large, or even controlling, in determining the question of profit or loss, they have little control—and in most cases none whatever—over the items specified in the other three groups; and that to admit them to participation in the net results of the whole business, while commendable as an act of generosity, is not defensible either as an equitable adjustment of the complex and often conflicting interests involved, nor as a theoretically correct solution of an economic problem.

The right solution of this problem will manifestly consist in allotting to each member of the organization an interest in that portion of the profit fund which is or may be affected by his individual efforts or skill, and in protecting this interest against diminution resulting from

the errors, of others, or from extraneous causes not under his control. Such a solution, while not simple, is attainable under many circumstances, and attainable by methods which experience has shown to be both practical and successful.

This resolution of the profit fund into component parts obviates many of the crudities in, and objections to, profit-sharing in its common form, but still leaves untouched another feature which is wrong in theory and often objectionable in practice, namely, the surrender by the principal of any portion of his legitimate profits without the assurance of an equivalent return from those on whom he bestows it. This, as said above, may be commendable as an act of charity, but as a solution of the problem in question it is neither complete nor accurate. Moreover, mere charity to those who do not need it is a doubtful good, and among intelligent and self-respecting men is not always relished. Certainly the problem we are considering will be best solved if it can be so formulated that the element of gratuity or charity, of giving without tangible consideration, can be eliminated, and that, as presented to the employee, it becomes an invitation from the principal that they should enter into an industrial partnership, wherein each will retain, unimpaired, his existing equitable rights, but will share with the other the benefits, if any are realized, of certain new contributions made by each to the common interest. For example, to recur to our former case, let us suppose that the wages of the operatives are already fairly adjusted according to the prevailing scale, so that for the

employer to offer them a portion of his profits without a guaranty of return would be equivalent to his giving them more than the fair market value of their services; while if, under this inducement, they gave him better or more work than before, they would not receive fair recompense in case, by reason of causes beyond their control, his business yielded no profit. But let us suppose, further, that the principal, wishing to enlist the self-interest of his employees to augment the profits of the business, should offer to the operatives a proposition somewhat as follows:

"I have already ascertained the cost of our product in labor, supplies, economy of material, and such other items as you can influence. I will undertake to organize and pay for a system whereby the cost of product in these same items will be periodically ascertained, and will agree to divide among you a certain portion (retaining myself the remainder) of any gain or reduction of cost, which you may affect by reason of increased efficiency of labor, or increased economy in the use of material, or both; this arrangement not to disturb your rates of wages, which are to continue, as at present, those generally paid for similar services."

Can there be any question as to the inherent fairness and accuracy of this solution of our problem, or any doubt as to its cheerful acceptance by intelligent labor? As to the latter point an emphatic answer has already been given by actual experience; as to the former a reply will be attempted in what follows.

The system for which I have adopted the designation

of "Gain-sharing" aims to recognize and provide for the conditions typified by the foregoing suppositious case, and to afford a basis for allotting to the employees in a business a share in the gain or benefit accruing from their own efforts, without involving in the account the general profits or losses of the business. The system is now in actual use as affecting some 300 employees, has been in operation more than two years and is demonstrated to be practical and beneficial. It has been applied to nearly one-half the divisions of a large and unusually varied industry, and will ultimately be extended to nearly all. As soon as understood by the employees, it is liked, and those not working under it in the instance referred to are desirous that it should be extended to include them. Its most obvious application is to productive industries, especially those whose product is of a simple or uniform kind; but it may be adapted to many others, and also to the business of large mercantile houses. It is equally applicable to cases where labor is employed either by the piece, by the day, or by contract, and in no way impairs the existing freedom of the relation between employer and employee, but tends to confer substantial benefit on both sides.

The basis or starting-point of the system is an accurate knowledge of the present cost of product (or, in the case of mercantile business, the cost of operating it), stated in terms which include the desired factors, that is, those which can be influenced or controlled by the employees who are to participate in the result, and which exclude all other factors. In some cases the previous

method of accounting or book-keeping may have been such as to supply this information, in which case the gain-sharing system can be easily and promptly organized. In others the existing books may contain the record from which the desired information can be digested and compiled. When no such record exists, however, the only safe method consists in devising and putting into action a system of accounts which will furnish the desired *data*, and in awaiting the accumulation thereby of information which, being based upon the operations of a reasonably long period—usually from six to twelve months—will constitute a fair mean of average.

The factors which should be included in, and those which should be excluded from, the account will vary with circumstances, each particular case having to be considered by itself. As a general rule it may be stated that, in the case of an account affecting the operatives in a producing or manufacturing business, the following items should be *included*, viz.: labor at cost, raw material, measured by quantity only (for which purpose an arbitrary fixed price may be assumed); incidental supplies, such as oil, waste, tools, and implements at cost; cost of power, light, and water, where means exist for correctly measuring them (for which purpose it often pays to provide local meters); cost of renewals and repairs of plant; and, finally, the cost of superintendence, clerk hire, etc., incident to the department covered by the system. In like manner the following items should be *excluded*, viz.: market values of raw material (which are liable to fluctuation); general expenses, whether re-

lating to management of works or to commercial administration, and, in general, all items over which the operatives can exercise no control or economy. Finally, the credit side of the account should be determined by the amount or volume of product measured by a scale of values fixed in advance, and based upon facts previously ascertained. For example, if, in a given case, it has been determined by the experience of several years that the present cost of product, measured by such items as are covered by the inclusive list above stated, is, say, one dollar ( $1 ) per unit of product, then the gain-sharing proposition might be formulated as follows : the principal would say to the employees in substance, "I will organize the system, will assume the cost of bookkeeping and other expenses incident to it, and will provide all the facilities reasonably required to assist you in reducing the cost of product ; I will credit the account with the output at the cost price heretofore obtaining, namely $1 per unit, and will charge it with the items in the inclusive list ; if at the end of the year the credits exceed the charges, I will divide the resulting *gain*, or reduction in cost, with you, retaining myself one portion —say one-half—and distributing the other portion among you *pro rata* on the basis of the wages earned by each during the year." Suppose, then, that at the end of the year it was found that the cost per unit of product had been reduced from $1 to 95 cents, that the total gain thus resulting was $800, and that the aggregate wages paid during the year had been $10,000. One-half of the gain would be $400, which would equal 4 per cent. on

the wages fund, so that each operative would be entitled to a dividend of 4 per cent. on his earnings during the year. This is equivalent to two weeks' extra wages, no mean addition to any income, and amounting, even in the case of a laborer earning $1.50 per day, to a cash dividend of $18 at the end of the year.

In the practical application of the system several important details have to be determined, for which no general rule can be laid down. Of these the most important is the question of the division of the gain or profit between employer and employees. In each of the twenty-one gain-sharing contracts which I have thus far instituted, it has seemed proper to make this division an equal one,—one-half to the principal and one-half to the operatives,—and the results thus far have justified the rule and proved generally satisfactory to both parties to the contract. Obviously, however, different circumstances may justify or require a different basis of division.

Another important question is the share of the profit fund or *gain* apportioned to the foreman, overseer, or contractor having immediate control of the operatives interested under the system. Where such person is employed under salary he may share *pro rata* with the operatives, but as this would tend to diminish his share with any increase of responsibility due to the need of an increased number of subordinates, I prefer to allot to him a definite part of the profit fund. Assuming fifty to be the average number of employees under one foreman, I regard ten to fifteen per cent. of the profit fund as about the proper allotment to the foreman, leaving

forty to thirty-five per cent. for his subordinates, where fifty per cent is retained by the employer.

As the foreman has more power and control than any subordinate, it is proper that his interest should be larger, and it is expedient, also, in adjusting his total compensation, to make a considerable fraction of it contingent upon the results of his work. Where the "contract system" of work prevails, I have adopted the rule of paying the contractor, like his helpers, by the hour; his "basis rate," or rate per hour, being determined by adding together the three following factors, viz: (1) his value as a workman, usually that of his best helpers; (2) one half cent per hour for each completed year of service as contractor, in recognition of increased value due to experience; and (3) a figure representing a very small but definite percentage on the aggregate amount of his contract earnings, in recognition of the fact that his responsibility varies somewhat with the volume of work under his control. The first of these items is usually constant; the second causes a slight annual increase in the "basis rate;" while the third tends to increase the rate when the volume of business is large, and to reduce it when business falls off. The percentage of the profit fund or "gain" alloted to a contractor may be larger, proportionately, than to a salaried foreman, depending upon his duties, his liability for quality of product, and the amount of his "basis rate" or hourly wages. As in the former case, however, it is desirable that a considerable fraction of his total compensation should be derived from the profit fund, and thus be contingent upon the results of his work.

A third point to be considered is the basis of participation on which the dividend to the operatives shall be apportioned among them. The simplest plan, and the one which I have adopted in practice, is to distribute the total profit fund allotted to the operatives on the basis of the actual wages earned by each during the year, including in the account everyone employed during that time, even if for one day only. If a dividend is earned it is not payable until the year is closed, when it is paid in cash, in the same manner as the regular wages, but enclosed in a special "dividend envelope," on which is stated the total annual wages of the recipient, and the rate and amount of his dividend. The rules should provide for the disposition of unclaimed dividends, which may very properly go into the treasury of a mutual benefit fund, if such an organization exists, and should also be carefully framed with reference to local laws, in order to avoid unforeseen liabilities and complications.

It has been found feasible, and very beneficial, to have posted in each room or department where the gain-sharing system is in force, a suitable blank, preferably under glass, on which can be entered each month the net results of the system during the preceding month, and including a statement of the *rate* of dividend earned since the beginning of the contract year. The stimulus thus given to the interest of the employees is very marked.

Another point of much importance is the question of the length of time during which a contract for "gain-sharing" shall continue without modification. Its in-

ception is voluntary with the employer, and he may impose on the contract any conditions he sees fit, since its whole purport is to tender to the employee an interest in excess of his stipulated wages, from which it is expected that he will gain an increase of his compensation but under which he cannot possibly suffer loss. Such a contract, however, when once definitely entered into is, like other contracts, only amenable to revision by the joint consent of both parties to it. It is important, therefore, that its provisions be carefully considered in advance.

The length of time which it is desirable to adopt for a gain-sharing contract depends greatly upon the conditions of the case. As already explained, the starting-point of the system is a knowledge of the previous *cost of product*, the "gain" or increased economy in this constituting the fund out of which the increased compensation to labor is to be paid. When, therefore, the cost of product is already accurately known, a gain-sharing contract may safely be made for a considerable length of time, whereas, when the cost is not well known, it is better to fix its terms for a shorter period, in order that they may be revised when the necessary information has been obtained. The best results will be obtained, however, when the contract is definitely fixed for a reasonably long period, say from three to five years, or even longer. A necessary element in the case is the adoption of a "contract price" for each article to be produced, by which, as previously explained the credit side of the account may be determined. At the begin-

ning of a contract the employer obviously has the right to adopt whatever "contract prices" he pleases, since their purpose is merely to serve as a basis from which to compute the "gain" in which he voluntarily tenders participation to the employees, and since the contract does not diminish the obligation of the employer to pay each employee his stipulated wages. Presumably the employer will adopt reasonably low contract prices, that is, closely approximating to previous cost; because to do otherwise would be prejudicial to his own interests, although to fix them on too low a scale would defeat the object of the system by leaving no opportunity for "gain," and hence no stimulus to increased efficiency of the employee. In like manner, at the expiration of a contract, the option and right reverts to the employer of revising the "contract prices" before offering a renewal of the contract; in which event, if during the previous term the cost of product has been considerably reduced, he will presumably (although this is not always the wisest course) proportionately reduce the contract prices. If, therefore, the contract period be short, the employee will naturally ask himself whether it is to his interest, for the sake of a small increase of compensation during that period, to make increased exertion in view of the fact that, at the end of the period, the employer will probably again reduce prices to a point where, in order to increase his earnings, the employee would have to exert himself even more than at first. If, however, the contract price be definitely fixed for a long period, the employee can afford, for the sake of

present gain, to disregard this question as one only affecting a somewhat remote future, and to use his best efforts and intelligence to effect a reduction in the cost of product. As a result of this the employer will be able, when the opportunity for a revision of prices arises, to make a larger reduction than he would probably attain in the same time under the plan of frequent revisions, and can also then afford to act more liberally toward the employees in the matter. In my judgment, therefore, both parties will usually be benefitted by having a long contract period in all cases where the previous cost of product is well known, and where no radical change of product or methods is likely to occur.

The simplest application of the gain-sharing system is to cases where work has already been done by contract,—that is, where one person employed for the purpose, is paid for the finished product *by the piece*, the wages of his helpers being charged against his account; and it can be readily organized in any case where the nature of the product is such as to adapt it to being thus done "by contract." In this connection it is proper to note that the contract method, whether under the gain-sharing system or not, is entirely compatible with "piece-work," that is, an arrangement whereby each operative is paid for his individual product by the piece instead of by day's wages. In this case the amount of piece-work earnings is charged against the contract account in the same manner as the wages of persons employed by the day or hour, and is treated in the same manner as other earnings in computing the dividend of each operative

under a gain-sharing contract. In corroboration of this statement I may mention that I have already adopted gain-sharing in several cases where the work was previously and is still done under the "contract" system, and in which, also, the piece-work system has since been largely applied. We thus have the three systems of gain-sharing, contract work, and piece-work, all coexisting harmoniously, and all contributing to a common result.

Again, in the case of a foundry, the gain-sharing system can be easily and advantageously applied. Here economy of material as well as efficiency of labor is largely under control of the operatives, and should be made a factor in the account. This can be accomplished by basing the "cost of product" upon the ascertained results of a previous period, labor and miscellaneous items of small supplies being charged up at actual cost, and fuel and metal being charged according to an arbitrary scale of fixed prices, which may conveniently be determined by adopting the average market rate during the previous year, or at its close. The arbitrary values for material which are thus adopted are then incorporated in the gain-sharing contract, and remain unchanged during its period. The "contract prices" for finished product are deduced from the actual results of the preliminary period, the cost of material being calculated by extending the actual quantities at the arbitrary prices per pound or other unit which may have been adopted for the proposed contract, the employer using his discretion as to how close the contract prices should be to

previous actual costs. Where the foundry product is of varied character, a separate price is fixed for each class of castings, and a record kept of the output of each.

Gain-sharing may thus be adapted to industries of almost any kind in which it is feasible, by reasonable expenditure, to differentiate those elements of cost which can be influenced by the persons who are to participate in the resulting gain from those which are beyond such influence or control. Careful and intelligent consideration must be given to properly adapting the system to the varied circumstances and details of each case; and the experience of several renewals of a gain-sharing contract, each accompanied by the modifications and improvements which are the outcome of experience, may be needed to attain the highest results. In my own experience I have failed, in a few cases, properly to adjust the conditions, and hence have seen the first year close with an apparent loss instead of a gain. In such cases a careful analysis of the operations of the year will usually explain the cause of disappointment and indicate the remedy. The first year of a contract for gain-sharing is apt to be disappointing to its promoter, owing to lack of interest, faith, and comprehension on the part of the employees. These all vanish, however, under the convincing argument of a *cash dividend*, and after the first of these has been paid there is usually a marked increase of interest in the plan.

Appended hereto are several papers illustrative of the working of the system in actual practice. The first of these—Appendix A—gives the results obtained in

the case of a number of the contracts to which I have applied the gain-sharing system, two of these covering a period of two years each. All of the others are now running on the second year, but only the results of the first year are here stated. The "contract prices" adopted for these gain-sharing accounts were in some cases the actual previous costs, but in a majority of cases the contract prices were fixed at rates which were a reduction of from ten to twenty per cent., and in one case of thirty per cent., from previous costs. These reductions were made advisedly, and only in cases where there was good reason to believe that increased effort would result in very considerable reductions of costs. In most cases the results have justified the reductions, and even on the basis of the new prices the contracts have yielded fair profits or dividends.

Appendix B is a transcript of one of the monthly exhibits mentioned above as being posted in the room or shop where the system is in force. These figures were inserted in the blank, month by month during the year, and gave information to the employees of the results of their work as affecting their interests under the gain-sharing contract. In this case the proportion of gain alloted to helpers was twenty-five per cent., and the net result of the operations for the year yielded a dividend to them of 5.7 per cent. on their wages or earnings during the year.

Appendix C shows the rules governing the application of the gain-sharing system to the iron foundry in the works of the Yale & Towne Manufacturing Com-

pany, at Stamford, Connecticut. Where the system is applied to a shop or department in which contract work obtains, the rules require modification in certain details, but are substantially the same in principle as those given herewith. In all cases the rules will require careful adaptation to the details of the particular work to which they relate, and to the methods of shop management and organization which are in use.

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## APPENDIX A.

| Contract No. | Term. | Helpers' Earnings. | Gain or Loss. | Helpers' Share. | Rate of Divid'nd. Per Ct. |
|---|---|---|---|---|---|
| 1 | 5 years. | $13,080 43 | $3,388 53 | $850 18 | .065 |
| 2 | 5 " | 9,216 87 | *37 59 | . . . | . . |
| 3 | 5 " | 3,666 34 | 840 05 | 208 98 | .057 |
| 4 | 3 " | 4,936 54 | 573 58 | 148 09 | .03 |
| 5 | 5 " | 910 22 | *48 52 | . . . | . . |
| 7 | 3 " | 3,861 28 | 537 72 | 134 43 | .035 |
| 8 | 3 " | 1,012 92 | 447 59 | 111 42 | .11 |
| 9 | 3 " | 419 55 | 109 04 | 27 27 | .065 |
| 10 | 5 " | 17,696 47 | 1,256 37 | 318 53 | .018 |
| 15 | 5 " | 728 53 | 358 20 | 89 62 | .123 |
| | | SECOND YEAR. | | | |
| 1 | | $14,096 05 | $3,251 04 | $817 56 | .058 |
| 3 | | 3,732 21 | 1,027 20 | 261 15 | .07 |

* Losses.

## APPENDIX B.

THE YALE & TOWNE MANUFACTURING CO.

*Monthly Accounts Relating to Contract No. 3—1887.*

| MONTHS. | TOTAL PROFIT FOR MONTH. | PROFITS FROM BEGINNING OF YEAR. | | | MONTHLY CHARGES FOR TOOLS. | MONTHLY CHARGES FOR SUPPLIES. |
|---|---|---|---|---|---|---|
| | | Total Amount. | 25 per ct. belong'g to helpers | Percentage on Wages. | | |
| January . . . . | *$45 52 | | | | $55 84 | $3 95 |
| February . . . | 85 72 | $40 20 | $10 05 | .017 | 46 85 | 2 97 |
| March . . . . | 115 53 | 155 73 | 38 93 | .039 | 78 13 | 7 62 |
| April . . . . | 98 48 | 254 21 | 63 55 | .046 | 35 57 | 5 98 |
| May . . . . | *51 46 | 202 75 | 50 69 | .0307 | 37 16 | 1 75 |
| June . . . . | 182 90 | 385 65 | 96 41 | .0505 | 26 66 | 2 04 |
| July . . . . | 9 12 | 394 77 | 98 69 | .046 | 17 25 | 2 74 |
| August . . . . | 76 12 | 470 89 | 117 72 | .049 | 27 10 | 2 02 |
| September . . | 8 64 | 479 53 | 119 88 | .044 | 44 20 | 3 14 |
| October . . . . | 114 76 | 594 29 | 148 57 | .0499 | 56 96 | 6 27 |
| November . . | *94 72 | 499 57 | 124 89 | .0378 | 58 30 | 75 |
| December . . . | 340 48 | 840 05 | 210 01 | .057 | 27 30 | 4 56 |
| Totals for year, | 840 05 | 840 05 | 210 00 | .057 | 511 32 | 43 79 |

* Losses.

## APPENDIX C.

THE YALE & TOWNE MFG. COMPANY, STAMFORD, CONN. RULES FOR "GAIN-SHARING" SYSTEM IN IRON FOUNDRY, DECEMBER, 1887.

### 1.—CONTRACT PERIOD.

The present contract between the company and the employees of the Foundry will cover a period from December 1st, 1887, to December 1st, 1888, and will be subject to revision after the latter date.

### 2.—The System.

The "gain-sharing system" has been in operation during 1887 throughout the greater part of Dept. A, where some 200 men are now at work under it. Its essential principle is this: that out of each $100 of savings or "gain" in the cost of product, in labor and supplies, the Company retains only $50, the other $50 being divided among the employees in the Department. To accomplish this the Company agrees to organize the method of operation, to keep the necessary accounts, and in general to facilitate matters so far as it reasonably can; the employees, on the other hand, agree to use their best efforts to increase the efficiency of their work, to economize in the use of supplies and material, and in general to do their share toward reducing the cost of finished products.

### 3.—Contract Prices.

To establish a basis by which to measure the saving or gain effected, the following plan has been adopted. The average prices for metal and fuel which prevailed during the past six months have been carefully ascertained, and these prices have been adopted for the contract period; applying these prices to the product of the Foundry for the past six months, all other items of labor and supplies being extended at their actual amounts, the cost per pound of castings of each class during the past six months has been ascertained; the prices thus ascertained are adopted as the *basis prices* for the contract period.

### 4.—Contract Profit or Gain.

At the close of each month of the contract period the cost of castings produced during the month will be ascertained by charging up the metal and fuel at the *fixed prices* adopted as above, and charging all other items, including wages and supplies, at actual cost. If the cost of castings thus ascertained is less than the *basis cost* determined as above, the difference between the two will be the saving or gain for the month. The result of each month's operations will be posted in the Foundry for the information of the employees.

### 5.—Division of Profits.

Within thirty days after the close of the contract year the total amount of saving or gain will be divided as follows:

Fifty per cent. will be retained by the Company.

Ten per cent. will be allotted to the Foreman of the Foundry.

Forty per cent. will be distributed among the employees of the Foundry in the proportion of the actual wages earned by each during the contract year.

### 6.—Wages Rates.

The wages of each employee will be fixed, as heretofore, by the Foreman of the Foundry, who will continue to have full discretion in the employment and discharge of the help required, and in the direction of their work.

### 7.—Payment of Profits.

Each employee will be entitled to his pro rata share of the profits, whether he has worked during the whole year or only a portion thereof. Any share of profits belonging to those who may honorably leave the Company's service during the year will be forwarded to them, provided they shall have given proper information as to their address. Any profits due to employees, and not claimed within three months after the close of any yearly contract period, will thereby become forfeited: all sums thus forfeited will be paid over by the Company to the Yale & Towne Mutual Benefit Society.

### 8.—Piece Work.

Wherever feasible the system of piece work will be employed, the piece rates being fixed by the Foreman subject to approval by the Company. All employees, whether working by the day or by the piece, will be entitled to their proportionate share of the annual profits on the basis of the actual wages earned by each.

### 9.—Foundry Supplies.

The Foundry account will be charged with all supplies furnished by the Company. The items so charged will include metals, fuel, sand, sieves, files, shovels, oil, waste, brooms, repairs, and, in general, everything consumed in the Foundry.

The supplies on hand at the beginning of the contract period will be charged to the Foundry account, and those on hand at the end of the year will be credited to the same account.

10.—GUARANTY.

The Company guarantees the payment to the employees of the Foundry of the regular wages earned by each, on day work or piece work, irrespective of whether this contract shows a profit or not.

11.—CONDITIONS.

The effect of the system being to give every workman employed under this contract a participation in the profits resulting from it, it is hereby stipulated as a condition of the employment of each and every person engaged under this system, that, in consideration of the interest assigned him in the profits of the contract, all claim thereto shall be forfeited by him in the event of his discharge by reason of misconduct or incompetency, or in the event of his combining with others in any way to disturb or affect the relations between the Company and its employees. This provision in no way curtails the right of each employee to negotiate with the Company, through the Foreman, in regard to his own rate of wages, nor does it in any way impair the title of each employee to his proportionate share of the profits in the event of his honorably leaving the Company's service, whether at its desire or his own.

12.—SHOP RULES.

All employees will continue to be governed by the Shop Rules of the Company, which are hereby referred to and made a part of this contract and agreement.

# THE PREMIUM PLAN OF PAYING FOR LABOR.

BY F. A. HALSEY.

This plan has been devised in order to overcome the objections inherent in the other plans in general use. It accomplishes this purpose without introducing corresponding objections of its own. Its merits are best shown by contrasting it with the other plans in common use, and it will be discussed with them in the following order:

I. The day's-work plan.
II. The piece-work plan.
III. The profit-sharing plan.
IV. The premium plan.

## I. THE DAY'S-WORK PLAN.

Under this method the workman is paid for and in proportion to the time spent upon his work. The objections to the plan are well known. Analyzed to their final cause, they spring from the fact that any increase of effort by the workman redounds solely to the benefit of the employer, the workman having no share in the consequent increase of production. He has consequently no inducement to exert himself and does not exert himself. Under this system, especially in a manufacturing business, matters naturally settle down to an easy-going pace, in which the workmen have little interest in their work, and the employer pays extravagantly for his product.

II. THE PIECE-WORK PLAN.

Under this plan the workman is paid for and in proportion to the amount of work done. It is a natural attempt to overcome the objections to the day's-work plan. It has the appearance of being just and of being based upon correct principles. Nevertheless, extended inquiry has convinced the writer that it seldom works smoothly, and never produces the results which it should.

An employer who has become dissatisfied with the results of the day's-work plan, and decides to adopt piece-work, usually reasons that work which is costing in wages, say one dollar per piece, could, with some extra effort be produced on the existing scale of wages for about eighty cents; and desiring to give the workman some inducement offers him ninety cents per piece, thereby dividing the expected saving with him. The trouble begins at once. The workman does not believe that he can "make wages" at the rate offered, and objects. He is, however, finally induced or compelled to try it, and immediately proceeds to astonish himself and all others by increasing his output far beyond the expected 25%. His earnings increase with startling rapidity, *but the cost of work remains where set, at ninety cents per piece*, and the employer soon finds that instead of a substantially equal division of the savings he is getting but little, and the workman practically all of it. He accordingly proceeds to cut the piece price, and the fatal defect of the system appears. This cut is in appearance and in fact an announcement to the workman that his earnings will not be allowed to exceed a

certain amount, and that should he push them above that amount he will be met with another cut. Cutting the piece price is simply killing the goose that lays the golden egg. Nevertheless, the goose must be killed. Without it the employer will continue to pay extravagantly for his work; with it he will stifle the rising ambition of his men. The difficulties of the day's-work and piece-work plans are thus seen to be the exact antitheses of one another. Analyzed to their final cause, the difficulties with the piece-work plan spring from the fact that the piece price once set, any increase of effort by the workman redounds to *his own* benefit alone—the employer having no share in the consequent saving of time. To obtain a share he cuts the piece price, with the consequences stated. Under this system matters gradually settle down as before to an easy-going pace in which the workmen approach the limit of wages as nearly as they consider prudent. Their earnings are somewhat more and the cost of the work is somewhat less than under the day's-work plan, but there is no more spirit of progress than under the older method. The employer is constantly on the lookout for a chance to cut the piece prices, that being his only method of reducing cost; and the men are constantly on the lookout to defeat the employer's well understood plan, knowing, as they do, that any one who is so unwise or so unfortunate as to do an increased amount of work will be in effect punished for it by having his piece price cut and himself thereby compelled to work harder in the future for the old amount of income. The sys-

tem makes the interest of the employer and employee antagonistic, and hence of concerted effort toward a progressive reduction of cost there is none. This I believe to be the usual and natural history of the piece-work plan. I know it to represent the situation in some of the foremost machine shops of the country. An additional objection to the plan grows out of the fact that it requires a knowledge and record of the cost of each piece of a complicated machine, and oftentimes of each operation on each piece. This limits its range of application to products which are produced in considerable quantities.

### III. THE PROFIT-SHARING PLAN.

This plan was originally devised in the effort to avoid the objections to the two former plans. Under it, in addition to regular wages, the employees are offered a certain percentage of the final profits of the business. It thus divides the savings due to increased production between employer and employee, and at first sight appears to meet the difficulties of the plans thus far discussed; but, nevertheless, on analysis, will be found to be as defective as they, both in principle and application. The leading objections to the plan are the following:

*First.* The workmen are given a share in what they do not earn. Increased profits may arise from more systematic shop management, decreased expenses of the sales department, or many other causes with which the workmen have nothing to do. Anything given them

from such sources becomes simply a gift, the result of which is wholly pernicious—in fact the entire system savors of patronage and paternalism.

*Second.* The workmen share, regardless of individual deserts. An active, energetic workman cannot have the same incentive to increased exertion under a system which divides the results of his efforts among a dozen lazy fellows at his side that he would have under one in which his earnings depend on himself alone; on the other hand, a lazy workman would naturally consider it much easier to take his portion of the earnings of his fellows than to exert himself and then divide the results with all the others of the force.

*Third.* The promised rewards are remote. The incentive cannot be as great under a system which computes and divides the savings once or twice a year as under one which pays out the extra earnings week by week.

*Fourth.* The plan makes no provision for bad years. We hear much of profit sharing, but nothing of loss sharing. And yet the workman cannot expect to share the profits while others assume the losses; and *per contra*, those who assume the risk of loss cannot be expected to share the profits with those who have nothing at stake.

*Fifth.* The workmen have no means of knowing if the agreement is carried out. With their exaggerated ideas of the profits of business, the results must be in many cases disappointingly small, and they will doubt the honesty of the division. What is to be done in such a

case? Invite the workmen to appoint a committee to examine the books, and report? Most employers will demur at this, and yet without it the employees can have no assurance of good faith; and were it done, what good could result? How many workmen's committees are there who are sufficiently versed in modern accounts to form any idea of the proceeds of the year's business from an examination of the books? In this light the profit-sharing plan is seen to be an agreement between two parties, the first of whom has every temptation and opportunity to cheat the second, while the second has no means of knowing if he has been cheated, and no redress in any case. In the present state of human nature this cannot be expected to be satisfactory to the second party. The fact that the plan has worked with apparent success in some instances and for considerable periods of time proves nothing. The most disastrous boiler explosions and bridge failures have been preceded by long periods of apparent safety. Even the Conemaugh dam held water for many years. It is a truism that the most rickety and unsafe devices often serve their purpose for long periods. At the beginning the workmen look on the amount received at the annual division as a bonus, and anything is better than nothing; but later on they will look on it as theirs by right of having earned it, and the above situation is certain to arise. The fact is, that the profit-sharing plan is wrong in principle, and cannot be in any large sense a solution of the wages problem.

## IV. THE PREMIUM PLAN.

Taking up now the subject proper of this paper, it aims at a division of the savings due to increased production between the employer and employee, but by a direct method instead of the circuitous one of the profit-sharing plan. The plan assumes two slightly different forms, according to the nature of the work; one form being suited to work produced in such quantities as to be reducible to a strictly manufacturing basis, and the other form to the more limited production of average practice. In both forms the essential principle is the same, as follows: The time required to do a given piece of work is determined from previous experience, and the workman, in addition to his usual daily wages, is offered a premium for every hour by which he reduces that time on future work, the amount of the premium being less than his rate of wages. Making the hourly premium less than the hourly wages is the foundation stone on which rest all the merits of the system, since by it if an hour is saved on a given product the cost of the work is less and the earnings of the workman are greater than if the hour is not saved, the workman being in effect paid for saving time. Assume a case in detail: Under the old plan a piece of work requires ten hours for its production, and the wages paid is thirty cents per hour. Under the new plan a premium of ten cents is offered the workman for each hour which he saves over the ten previously required. If the time be reduced successively to five hours the results will be as follows:

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Time consumed. | Wages per piece. | Premium. | Total cost of work = col. 2 + col. 3. | Workman's earnings per hour = col. 4 ÷ col. 1. |
| Hours. | $ | $ | $ | $ |
| 10 | 3.00 | 0 | 3.00 | .30 |
| 9 | 2.70 | .10 | 2.80 | .311 |
| 8 | 2.40 | .20 | 2.60 | .325 |
| 7 | 2.10 | .30 | 2.40 | .343 |
| 6 | 1.80 | .40 | 2.20 | .366 |
| 5 | 1.50 | .50 | 2.00 | .40 |

This table illustrates the manner in which the cost of the work diminishes and the workman's earnings increase together until, to cite the extreme case of the last line, if the output be doubled, the wages paid per piece will be reduced 33⅓%, but the workman's earnings per hour will be increased 33⅓%. Were the premium less than ten cents per hour, the reduction in cost for each hour saved would be greater, and the workman's earnings less. On the other hand, the workman would have a smaller incentive, and the time would not be reduced so much. The output would be less, and the net result might be worse for both employer and employee. This raises the inevitable question: What should be the rate of the premium? Nothing but good sense and judgment can decide in any case. In certain classes of work an increase of production is accompanied with a proportionate increase of muscular exertion, and if the work is already laborious a liberal premium will be required to produce results. In other classes of work increased pro-

duction requires only increased attention to speeds and feeds with an increase of manual dexterity and an avoidance of lost time. In such cases a more moderate premium will suffice. Any attempt, however, on the part of the employer to be greedy and squeeze the lemon too dry will defeat its own object, since if a trifling premium be offered, the workman will not consider it worth while to exert himself for so small a reward, and the expected increase of output will not take place. On the other hand, if the premium offered be too high, the employer will simply pay more than necessary for his work, though less than he has been paying. If the rate of premium is decided upon judiciously, it may and should be made permanent. No cutting down of the rate should ever be made unless, indeed, improved processes destroy the significance of the first time base. Every increase of earnings is necessarily accompanied by a corresponding decrease of cost, and if the premium be such as to give these a satisfactory relation, the workman may be assured that there will be no limit set to his earnings; that the greater they are the more satisfactory they will be to the employer. The importance of this cannot be too strongly insisted upon. If the premiums be cut the workmen will rightly understand it to mean, as under the piece-work plan, that their earnings are not to be permitted to pass a certain limit, and that too much exertion is unsafe. The very purpose of the plan is to avoid this by so dividing the savings between employer and employee as to remove the necessity for cutting the rate, and hence enable the workman's earnings to be

limited only by his own ability and activity. The baneful feature of the piece-work plan is thus completely obviated, and instead of periodical cuts with their resulting ill-feeling, the premiums lead the workman to greater and greater effort, resulting in a constant increase of output, decrease of cost, and increase of earnings.

The broad-minded employer will not fail to recognize that his own gain from the system comes largely from the increased production from a given plant, since not only does the system reduce the wages cost of the piece of work in hand, but in so doing it increases the capacity of the plant for other work to follow. The advantages from this source are so great as to render unnecessary any refined hair-splitting as to the rate of the premium.

Such is the premium plan, and the writer confidently predicts that the more it is studied the more perfect will appear its adaptation to the requirements of industrial enterprise and human nature. Surely, a system which increases output, decreases cost, and increases workman's earnings simultaneously, without friction, and by the silent force of its appeal to every man's desire for a larger income, is worthy of attention. In addition to the commanding features noted it has others of lesser note. The transition to it from the day's-work plan is easy and natural. It does not involve a reorganization of the system of book-keeping, but only an addition, and a small one, to the existing system. No opposition to it, organized or otherwise, is possible, since there is

nothing compulsory about it, and nothing tangible to oppose. It is simply an offer to gratify one of the strongest passions of human nature, and the difficulty often found in introducing piece-work cannot occur with this.

In carrying out the plan in connection with work which has been reduced to a manufacturing basis, the writer finds the form of time ticket shown on the following page convenient.

This ticket is issued by the foreman, the blanks at the top being filled up by him. If desired as a check he punches a hole on the line, indicating the hour when the work is given out, repeating the same when the work and ticket are returned. The record of the time is kept by drawing a line between various hour marks, an operation which the most illiterate can perform.[1] The ticket provides for several days' work, and is not returned until the work is completed, when it contains the record of the entire job.[2] On the back of the ticket is printed the following:

"According to previous experience this work should require . . . hours. If completed in less time than that a premium of . . . cents will be paid for each hour saved."

[1] Attention was called to this form of time ticket by Professor Hutton in Vol. IX. of the *Transactions of the American Society of Mechanical Engineers*, page 386.

[2] This rule holds, even when the job after being partly finished is interrupted by something more pressing. In such a case the ticket is taken up by the foreman in order to insure that the entries have been made for the completed work. He issues the ticket again when the work is resumed, and when all is completed this ticket goes to the office, where a single entry in the cost book records what, under the usual method, might require a half dozen or even more entries.

# TIME TICKET.

**Name of Part** ..... **No. of Pieces** .....

**Operation** ..... **Workman** .....

**HOURS.**

| DATE. | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 10½ | 11 | 11½ | 12 | 12½ | 1 | 1½ | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | OVER TIME. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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*Machine set by* ..... *Time* ..... *hours.*

When the ticket is returned, a comparison of the back with the front shows the premium earned. This is entered opposite the workman's name, in a book kept for the purpose, which is a companion to the usual time book or pay roll. On pay day the accrued premiums are paid to each workman along with the regular wages. The cost book is written up from the ticket in the usual way, except that as the ticket usually contains the record of several days' work, the labor of keeping the cost book is much abridged.

On work which, while produced as a regular product, is still not produced in sufficient quantity to justify recording the cost of each part, the premium offer is made to the group of men who carry out the work. The proposition is made as a posted notice, or otherwise in the following form:

"According to previous experience this work should require . . . hours. If completed in less time than that a premium of . . . cents per hour saved will be divided among those working on the machine, division to be in proportion to time spent on the work."

In this form the system loses the advantage of dealing directly with the individual, and the second objection to the profit-sharing plan is introduced, though in a modified degree, as a small group of men is dealt with instead of the entire force. The remaining objections to the profit-sharing plan are not introduced, and on such work the plan proposed is distinctly superior, though lacking theoretical perfection. The piece-work plan does not apply to work of this kind, and hence there can be no comparison between it and the plan under discussion.

On contract work undertaken for the first time the method is the same, except that the premium is based on the *estimated* time for the execution of the work.

The system is thus applicable to all classes of machine-shop work except "jobbing" or work done by the hour, and there is no very vociferous demand from the shops for a method of reducing the time on that class of work.

The writer believes that, judiciously administered, the plan proposed will produce a larger output and cheaper work, and at the same time pay higher wages than any other whatsoever.

# A PIECE-RATE SYSTEM

BEING A STEP TOWARD PARTIAL SOLUTION OF THE LABOR PROBLEM.

BY FRED W. TAYLOR.

The ordinary piece-work system involves a permanent antagonism between employers and men, and a certainty of punishment for each workman who reaches a high rate of efficiency. The demoralizing effect of this system is most serious. Under it, even the best workmen are forced continually to act the part of hypocrites, to hold their own in the struggle against the encroachments of their employers.

The system introduced by the writer, however, is directly the opposite, both in theory and in its results. It makes each workman's interests the same as that of his employer, pays a premium for high efficiency, and soon convinces each man that it is for his permanent advantage to turn out each day the best quality and maximum quantity of work.

The writer has endeavored in the following pages to describe the system of management introduced by him in the works of the Midvale Steel Company, of Philadelphia, which has been employed by them during the past ten years with the most satisfactory results.

The system consists of three principal elements:

(1) An elementary rate-fixing department.

(2) The differential rate system of piece-work.

(3) What he believes to be the best method of managing men who work by the day.

Elementary rate-fixing differs from other methods of making piece-work prices in that a careful study is made of the time required to do each of the many elementary operations into which the manufacturing of an establishment may be analyzed or divided. These elementary operations are then classified, recorded, and indexed, and when a piece-work price is wanted for work the job is first divided into its elementary operations, the time required to do each elementary operation is found from the records, and the total time for the job is summed up from these data. While this method seems complicated at the first glance, it is, in fact, far simpler and more effective than the old method of recording the time required to do whole jobs of work, and then, after looking over the records of similar jobs, guessing at the time required for any new piece of work.

The differential rate system of piece-work consists, briefly, in offering two different rates for the same job, a high price per piece in case the work is finished in the shortest possible time and in perfect condition, and a low price if it takes a longer time to do the job, or if there are any imperfections in the work. (The high rate should be such that the workman can earn more per day than is usually paid in similar establishments.) This is directly the opposite of the ordinary plan of piece-work in which the wages of the workmen are reduced when they increase their productivity.

The system by which the writer proposes managing the men who are on day-work consists in paying *men* and not *positions*. Each man's wages, as far as possible,

are fixed according to the skill and energy with which he performs his work, and not according to the position which he fills. Every endeavor is made to stimulate each man's personal ambition. This involves keeping systematic and careful records of the performance of each man, as to his punctuality, attendance, integrity, rapidity, skill, and accuracy, and a readjustment from time to time of the wages paid him, in accordance with this record.

The advantages of this system of management are :

*First.* That the manufactures are produced cheaper under it, while at the same time the workmen earn higher wages than are usually paid.

*Second.* Since the rate-fixing is done from accurate knowledge instead of more or less by guess-work, the motive for holding back on work, or "soldiering", and endeavoring to deceive the employers as to the time required to do work, is entirely removed, and with it the greatest cause for hard feelings and war between the management and the men.

*Third.* Since the basis from which piece-work as well as day rates are fixed is that of exact observation, instead of being founded upon accident or deception, as is too frequently the case under ordinary systems, the men are treated with greater uniformity and justice, and respond by doing more and better work.

*Fourth.* It is for the common interest of both the management and the men to coöperate in every way, so as to turn out each day the maximum quantity and best quality of work.

*Fifth.* The system is rapid, while other systems are slow, in attaining the maximum productivity of each machine and man; and when this maximum is once reached, it is automatically maintained by the differential rate.

*Sixth.* It automatically selects and attracts the best men for each class of work, and it develops many first-class men who would otherwise remain slow or inaccurate, while at the same time it discourages and sifts out men who are incurably lazy or inferior.

*Finally.* One of the chief advantages derived from the above effects of the system is, that it promotes a most friendly feeling between the men and their employers, and so renders labor unions and strikes unnecessary.

There has never been a strike under the differential rate system of piece-work, although it has been in operation for the past ten years in the steel business, which has been during this period more subject to strikes and labor troubles than almost any other industry. In describing the above system of management the writer has been obliged to refer to other piece-work methods, and to indicate briefly what he believes to be their shortcomings.

As but few will care to read the whole paper, the following index to its contents is given:

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1. Capital demands fully twice the return for money placed in manufacturing enterprises that it does for real estate or transportation ventures. And this probably represents the difference in the risk between these classes of investments.

2. Among the risks of a manufacturing business, by far the greatest is that of bad management; and of the three managing departments, the commercial, the financiering, and the productive, the latter, in most cases, receives the least attention from those that have invested their money in the business, and contains the greatest elements of risk. This risk arises not so much from the evident mismanagement, which plainly discloses itself through occasional strikes and similar troubles, as from the daily more insidious and fatal failure on the part of the superintendents to secure anything even approaching the maximum work from their men and machines.

3. It is not unusual for the manager of a manufacturing business to go most minutely into every detail of the buying and selling and financiering, and arrange

every element of these branches in the most systematic manner and according to principles that have been carefully planned to insure the business against almost any contingency which may arise, while the manufacturing is turned over to a superintendent or foreman, with little or no restrictions as to the principles and methods which he is to pursue, either in the management of his men or the care of the company's plant.

4. Such managers belong distinctly to the old school of manufacturers; and among them are to be found, in spite of their lack of system, many of the best and most successful men of the country. They believe in men, not in methods, in the management of their shops; and what they would call system in the office and sales departments, would be called red tape by them in the factory. Through their keen insight and knowledge of character they are able to select and train good superintendents, who in turn secure good workmen; and frequently the business prospers under this system (or rather, lack of system) for a term of years.

5. The modern manufacturer, however, seeks not only to secure the best superintendents and workmen, but to surround each department of his manufacture with the most carefully woven net-work of system and method, which should render the business, for a considerable period at least, independent of the loss of any one man, and frequently of any combination of men.

6. It is the lack of this system and method which, in the judgment of the writer, constitutes the greatest risk in manufacturing; placing, as it frequently does, the

success of the business at the hazard of the health or whims of a few employees.

7. Even after fully realizing the importance of adopting the best possible system and methods of management for securing a proper return from employees and as an insurance against strikes and the carelessness and laziness of men, there are difficulties in the problem of selecting methods of management which shall be adequate to the purpose, and yet be free from red tape, and inexpensive.

8. The literature on the subject is meagre, especially that which comes from men of practical experience and observation. And the problem is usually solved, after but little investigation, by the adoption of the system with which the managers are most familiar, or by taking a system which has worked well in similar lines of manufacture.

9. Now, among the methods of management in common use there is certainly a great choice; and before describing the "differential rate" system it is desirable to briefly consider the more important of the other methods.

10. The simplest of all systems is the "day-work" plan, in which the employees are divided into certain classes, and a standard rate of wages is paid to each class of men; the laborers all receiving one rate of pay, the machinists all another rate, and the engineers all another, etc. The men are paid according to the position which they fill, and not according to their individual character, energy, skill, and reliability.

11. The effect of this system is distinctly demoralizing and levelling; even the ambitious men soon conclude that since there is no profit to them in working hard, the best thing for them to do is to work just as little as they can and still keep their position. And under these conditions the invariable tendency is to drag them all down even below the level of the medium.

12. The proper and legitimate answer to this herding of men together into classes, regardless of personal character and performance, is the formation of the labor union, and the strike, either to increase the rate of pay and improve conditions of employment, or to resist the lowering of wages and other encroachments on the part of employers.

13. The necessity for the labor union, however, disappears when *men* are paid, and not *positions*; that is, when the employers take pains to study the character and performance of each of their employees and pay them accordingly, when accurate records are kept of each man's attendance, punctuality, the amount and quality of work done by him, and his attitude towards his employers and fellow-workmen.

As soon as the men recognize that they have free scope for the exercise of their proper ambition, that as they work harder and better their wages are from time to time increased, and that they are given a better class of work to do—when they recognize this, the best of them have no use for the labor union.

14. Every manufacturer must from necessity employ a certain amount of day-labor which cannot come under

the piece-work system; and yet how few employers are willing to go to the trouble and expense of the slight organization necessary to handle their men in this way? How few of them realize that, by the employment of an extra clerk and foreman, and a simple system of labor returns, to record the performance and readjust the wages of their men so as to stimulate their personal ambition, the output of a gang of twenty or thirty men can be readily doubled in many cases, and at a comparatively slight increase of wages per capita!

15. The clerk in the factory is the particular horror of the old-style manufacturer. He realizes the expense each time that he looks at him, and fails to see any adequate return; yet by the plan here described the clerk becomes one of the most valuable agents of the company.

16. If the plan of grading labor and recording each man's performance is so much superior to the old day-work method of handling men, why is it not all that is required? Because no foreman can watch and study all of his men all of the time, and because any system of laying out and apportioning work, and of returns and records, which is sufficiently elaborate to keep proper account of the performance of each workman, is more complicated than piece-work. It is evident that that system is the best which, in attaining the desired result, presents in the long run the course of least resistance.

17. The inherent and most serious defect of even the best managed day-work lies in the fact that there is nothing about the system that is self-sustaining. When

once the men are working at a rapid pace there is nothing but the constant, unremitting watchfulness and energy of the management to keep them there; while with every form of piece-work each new rate that is fixed insures a given speed for another section of work, and to that extent relieves the foreman from worry.

18. From the best type of day-work to ordinary piece-work, the step is a short one. With good day-work the various operations of manufacturing should have been divided into small sections or jobs, in order to properly gauge the efficiency of the men; and the quickest time should have been recorded in which each operation has been performed. The change from paying by the hour to paying by the job is then readily accomplished.

19. The theory upon which the ordinary system of piece-work operates to the benefit of the manufacturer is exceedingly simple. Each workman, with a definite price for each job before him, contrives a way of doing it in a shorter time, either by working harder or by improving his method; and he thus makes a larger profit. After the job has been repeated a number of times at the more rapid rate, the manufacturer thinks that he should also begin to share in the gain, and therefore reduces the price of the job to a figure at which the workman, although working harder, earns, perhaps, but little more than he originally did when on day-work.

20. The actual working of the system, however, is far different. Even the most stupid man, after receiving two or three piece-work "cuts" as a reward for his having worked harder, resents this treatment and seeks a

remedy for it in the future. Thus begins a war, generally an amicable war, but none the less a war, between the workmen and the management. The latter endeavors by every means to induce the workmen to increase the out put, and the men gauge the rapidity with which they work, so as never to earn over a certain rate of wages, knowing that if they exceed this amount the piece-work price will surely be cut sooner or later.

21. But the war is by no means restricted to piece-work. Every intelligent workman realizes the importance, to his own interest, of starting in on each new job as slowly as possible. There are few foremen or superintendents who have anything but a general idea as to how long it should take to do a piece of work that is new to them. Therefore, before fixing a piece-work price, they prefer to have the job done for the first time by the day. They watch the progress of the work as closely as their other duties will permit, and make up their minds how quickly it can be done. It becomes the workman's interest then to go just as slowly as possible and still convince his foreman that he is working well.

22. The extent to which, even in our largest and best managed establishments, this plan of holding back on the work,—"marking time", or "soldiering", as it is called—is carried on by the men, can scarcely be understood by one who has not worked among them. It is by no means uncommon for men to work at the rate of one-third, or even one-quarter, their maximum speed, and still preserve the appearance of working hard. And

when a rate has once been fixed on such a false basis it is easy for the men to nurse successfully "a soft snap" of this sort through a term of years, earning in the meanwhile just as much wages as they think they can without having the rate cut.

23. Thus arises a system of hypocrisy and deceit on the part of the men which is thoroughly demoralizing and which has led many workmen to regard their employers as their natural enemies, to be opposed in whatever they want, believing that whatever is for the interest of the management must necessarily be to their detriment.

24. The effect of this system of piece-work on the character of the men is, in many cases, so serious as to make it doubtful whether, on the whole, well managed day-work is not preferable.

25. There are several modifications of the ordinary method of piece-work which tend to lessen the evils of the system, but I know of none that can eradicate the fundamental causes for war, and enable the managers and the men to heartily coöperate in obtaining the maximum product from the establishment. It is the writer's opinion, however, that the differential rate system of piecework, which will be described later, in most cases entirely harmonizes the interests of both parties.

26. One method of temporarily relieving the strain between workmen and employers consists in reducing the price paid for work, and at the same time guaranteeing the men against further reduction for a definite period. If this period be made sufficiently long, the men are tempted to let themselves out and earn as much

money as they can, thus "spoiling" their own job by another "cut" in rates when the period has expired.

27. Perhaps the most successful modification of the ordinary system of piece-work is the "gain-sharing" plan. This was invented by Mr. Henry R. Towne, in 1886, and has since been extensively and successfully applied by him in the Yale & Towne Manufacturing Co., at Stamford, Conn. It was admirably described in a paper which he read before this Society in 1888. This system of paying men is, however, subject to the serious, and I think fatal, defect that it does not recognize the personal merit of each workman; the tendency being rather to herd men together and promote trades-unionism, than to develop each man's individuality.

28. A still further improvement of this method was made by Mr. F. A. Halsey, and described by him in a paper entitled "The Premium Plan of Paying for Labor," and presented to this Society in 1891. Mr. Halsey's plan allows free scope for each man's personal ambition, which Mr. Towne's does not.

29. Messrs. Towne and Halsey's plans consist briefiy in recording the cost of each job as a starting-point at a certain time; then, if, through the effort of the workmen in the future, the job is done in a shorter time and at a lower cost, the gain is divided among the workmen and the employer in a definite ratio, the workmen receiving, say, one-half, and the employer one-half.

30. Under this plan, if the employer lives up to his promise, and the workman has confidence in his integrity, there is the proper basis for coöperation to secure

sooner or later a large increase in the output of the establishment.

Yet there still remains the temptation for the workman to "soldier" or hold back while on day-work, which is the most difficult thing to overcome. And in this as well as in all the systems heretofore referred to, there is the common defect that the starting-point from which the first rate is fixed is unequal and unjust. Some of the rates may have resulted from records obtained when a good man was working close to his maximum speed, while others are based on the performance of a medium man at one-third or one-quarter speed. From this follows a great inequality and injustice in the reward even of the same man when at work on different jobs. The result is far from a realization of the ideal condition in which the same return is uniformly received for a given expenditure of brains and energy. Other defects in the gain-sharing plan, and which are corrected by the differential rate system, are:

(1) That it is slow and irregular in its operation in reducing costs, being dependent upon the whims of the men working under it.

(2) That it fails to especially attract first-class men and discourage inferior men.

(3) That it does not automatically insure the maximum output of the establishment per man and machine.

31. Coöperation, or profit sharing, has entered the mind of every student of the subject as one of the possible and most attractive solutions of the problem; and there have been certain instances, both in England and

France, of at least a partial success of coöperative experiments.

So far as I know, however, these trials have been made either in small towns, remote from the manufacturing centres, or in industries which in many respects are not subject to ordinary manufacturing conditions.

32. Coöperative experiments have failed, and, I think, are generally destined to fail, for several reasons, the first and most important of which is, that no form of coöperation has yet been devised in which each individual is allowed free scope for his personal ambition. This always has been and will remain a more powerful incentive to exertion than a desire for the general welfare. The few misplaced drones, who do the loafing and share equally in the profits with the rest, under coöperation are sure to drag the better men down toward their level.

33. The second and almost equally strong reason for failure lies in the remoteness of the reward. The average workman (I don't say all men) cannot look forward to a profit which is six months or a year away. The nice time which they are sure to have to-day if they take things easily, proves more attractive than hard work with a possible reward to be shared with others six months later.

34. Other and formidable difficulties in the path of coöperation are, the equitable division of the profits, and the fact that, while workmen are always ready to share the profits, they are neither able nor willing to share the losses. Further than this, in many cases it is neither right nor just that they should share either in the profits or the losses, since these may be due in great part to

causes entirely beyond their influence or control, and to which they do not contribute.

35. When we recognize the real antagonism that exists between the interests of the men and their employers under all of the systems of piece-work in common use, and when we remember the apparently irreconcilable conflict implied in the fundamental and perfectly legitimate aims of the two, namely, on the part of the men,—

THE UNIVERSAL DESIRE TO RECEIVE THE LARGEST POSSIBLE WAGES FOR THEIR TIME ;

And on the part of the employers,—

THE DESIRE TO RECEIVE THE LARGEST POSSIBLE RETURN FOR THE WAGES PAID ;

What wonder that most of us arrive at the conclusion that no system of piece-work can be devised which will enable the two to coöperate without antagonism, and to their mutual benefit?

36. Yet it is the opinion of the writer that even if a system has not already been found which harmonizes the interests of the two, still the basis for harmonious coöperation lies in the two following facts:

*First. That the workmen in nearly*[1] *every trade can*

[1] The writer's knowledge of the speed attained in the manufacture of textile goods is very limited. It is his opinion, however, that owing to the comparative uniformity of this class of work, and the enormous number of machines and men engaged on similar operations, the maximum output per man and machine is more nearly realized in this class of manufactures than in any other. If this is the case, the opportunity for improvement does not exist to the same extent here as in other trades. Some illustrations of the possible increase in the daily output of men and machines are given in paragraphs 78 to 82.

*and will materially increase their present output per day, providing they are assured of a permanent and larger return for their time than they have heretofore received.*

*Second. That the employers can well afford to pay higher wages per piece even permanently, providing each man and machiue in the establishment turns out a proportionately larger amount of work.*

37. The truth of the latter statement arises from the well recognized fact that, in most lines of manufacture, the indirect expenses equal or exceed the wages paid directly to the workmen, and that these expenses remain approximately constant, whether the output of the establishment is great or small.

From this it follows that it is always cheaper to pay higher wages to the workmen when the output is proportionately increased: the diminution in the indirect portion of the cost per piece being greater than the increase in wages. Many manufacturers, in considering the cost of production, fail to realize the effect that the *volume of output has on the cost.* They lose sight of the fact that taxes, insurance, depreciation, rent, interest, salaries, office expenses, miscellaneous labor, sales expenses, and frequently the cost of power (which in the aggregate amount to as much as wages paid to workmen), remain about the same whether the output of the establishment is great or small.

38. In our endeavor to solve the piece-work problem by the application of the two fundamental facts above referred to, let us consider the obstacles in the path of

harmonious coöperation, and suggest a method for their removal.

39. The most formidable obstacle is the lack of knowledge on the part of both the men and the management (but chiefly the latter) of the quickest time in which each piece of work can be done; or, briefly, the lack of accurate time-tables for the work of the place.

40. The remedy for this trouble lies in the establishment in every factory of a proper rate-fixing department; a department which shall have equal dignity and command equal respect with the engineering and managing departments, which shall be organized and conducted in an equally scientific and practical manner.

41. The rate-fixing, as at present conducted, even in our best managed establishments, is very similar to the mechanical engineering of fifty or sixty years ago. Mechanical engineering at that time consisted in imitating machines which were in more or less successful use, or in guessing at the dimensions and strength of the parts of a new machine; and as the parts broke down or gave out, in replacing them with the stronger ones. Thus each new machine presented a problem almost independent of former designs, and one which could only be solved by months or years of practical experience and a series of break-downs.

Modern engineering, however, has become a study, not of individual machines, but of the resistance of materials, the fundamental principles of mechanics, and of the elements of design.

42. On the other hand, the ordinary rate-fixing (even

the best of it), like the old-style engineering, is done by a foreman or superintendent who, with the aid of a clerk, looks over the record of the time in which a whole job was done as nearly like the new one as can be found, and then guesses at the time required to do the new job. No attempt is made to analyze and time each of the classes of work, or elements of which a job is composed; although it is a far simpler task to resolve each job into its elements, to make a careful study of the quickest time in which each of the elementary operations can be done, and then to properly classify, tabulate, and index this information, and use it when required for rate-fixing, than it is to fix rates, with even an approximation to justice, under the common system of guessing.

43. In fact, it has never occurred to most superintendents that the work of their establishments consists of various combinations of elementary operations which can be timed in this way; and a suggestion that this is a practical way of dealing with the piece-work problem usually meets with derision, or, at the best, with the answer that "It might do for some simple business, but my work is entirely too complicated."

44. Yet this elementary system of fixing rates has been in successful operation for the past ten years, on work complicated in its nature and covering almost as wide a range of variety as any manufacturing that the writer knows of. In 1883, while foreman of the machine shop of the Midvale Steel Company of Philadelphia, it occurred to the writer that it was simpler to time each of the elements of the various kinds of work

done in the place, and then find the quickest time in which each job could be done, by summing up the total times of its component parts, than it was to search through the records of former jobs and guess at the proper price. After practising this method of rate-fixing himself for about a year as well as circumstances would permit, it became evident that the system was a success. The writer then established the rate-fixing department, which has given out piece-work prices in the place ever since.

45. This department far more than paid for itself from the very start; but it was several years before the full benefits of the system were felt, owing to the fact that the best methods of making and recording time observations of work done by the men, as well as of determining the maximum capacity of each of the machines in the place, and of making working-tables and time-tables, were not at first adopted.

46. Before the best results were finally attained in the case of work done by metal-cutting tools, such as lathes, planers, boring mills, etc., a long and expensive series of experiments was made, to determine, formulate, and finally practically apply to each machine the law governing the proper cutting speed of tools, namely, the effect on the cutting speed of altering any one of the following variables: the shape of the tool (*i.e.*, lip angle, clearance angle, and the line of the cutting edge), the duration of the cut, the quality or hardness of the metal being cut, the depth of the cut, and the thickness of the feed or shaving.

47. It is the writer's opinion that a more complicated and difficult piece of rate-fixing could not be found than that of determining the proper price for doing all kinds of machine work on miscellaneous steel and iron castings and forgings, which vary in their chemical composition from the softest iron to the hardest tool steel. Yet this problem was solved through the rate-fixing department and the "differential rate," with the final result of completely harmonizing the men and the management, in place of the constant war that existed under the old system. At the same time the quality of the work was improved and the output of the machinery and the men was doubled, and in many cases trebled. At the start there was naturally great opposition to the rate-fixing department, particularly to the man who was taking time observations of the various elements of the work; but when the men found that the rates were fixed without regard to the records of the quickest time in which they had actually done each job, and that the knowledge of the department was more accurate than their own, the motive for hanging back or "soldiering" on this work ceased, and with it the greatest cause for antagonism and war between the men and the management.

48. As an illustration of the great variety of work to which elementary rate-fixing has already been successfully applied, the writer would state that while acting as general manager of two large sulphite pulp mills he directed the application of piece-work to all of the complicated operations of manufacturing throughout one of

these mills, by means of elementary rate-fixing, with the result, within eighteen months, of more than doubling the output of the mill.

The difference between elementary rate-fixing and the ordinary plan can perhaps be best explained by a simple illustration. Suppose the work to be planing a surface on a piece of cast iron. In the ordinary system the rate-fixer would look through his records of work done by the planing machine, until he found a piece of work as nearly as possible similar to the proposed job, and then guess at the time required to do the new piece of work. Under the elementary system, however, some such analysis as the following would be made:

| *Work done by Man.* | *Minutes.* |
|---|---|
| Time to lift piece from floor to planer table . . . . . | —— |
| Time to level and set work true on table . . . . . | —— |
| Time to put on stops and bolts . . . . . | —— |
| Time to remove stops and bolts . . . . . | —— |
| Time to remove piece to floor . . . . . | —— |
| Time to clean machine . . . . . | —— |

| *Work done by Machine.* | *Minutes.* |
|---|---|
| Time to rough off cut ¼ in. thick, 4 feet long, 2½ in. wide . | —— |
| Time to rough off cut ⅛ in. thick, 3 feet long, 12 in. wide etc. | —— |
| Time to finish cut 4 feet long, 2½ in. wide . . . . . | —— |
| Time to finish cut 3 feet long, 12 in. wide, etc . . . . . | —— |
| Total . . . . . | —— |
| Add —— per cent. for unavoidable delays . . . . . | —— |

It is evident that this job consists of a combination of elementary operations, the time required to do each of which can be readily determined by observation.

This exact combination of operations may never occur again, but elementary operations similar to these will be performed in differing combinations almost every day in the same shop.

A man whose business it is to fix rates soon becomes so familiar with the time required to do each kind of elementary work performed by the men, that he can write down the time from memory.

In the case of that part of the work which is done by the machine, the rate-fixer refers to tables which are made out for each machine, and from which he takes the time required for any combination of breadth, depth, and length of cut.

49. While, however, the accurate knowledge of the quickest time in which work can be done, obtained by the rate-fixing department and accepted by the men as standard, is the greatest and most important step toward obtaining the maximum output of the establishment, it is one thing to know how much work can be done in a day and an entirely different matter to get even the best men to work at their fastest speed or anywhere near it.

50. The means which the writer has found to be by far the most effective in obtaining the maximum output of a shop, and which, so far as he can see, satisfies the legitimate requirements, both of the men and management, is the *differential rate system of piece-work.*

This consists briefly in paying a higher price per piece, or per unit, or per job, if the work is done in the shortest possible time and without imperfections, than is paid if the work takes a longer time or is imperfectly done.

51. To illustrate: Suppose 20 units or pieces to be the largest amount of work of a certain kind that can be done in a day. Under the differential rate system, if a workman finishes 20 pieces per day, and all of these pieces are perfect, he receives, say, 15 cents per piece, making his pay for the day $15 \times 20 = \$3$. If, however, he works too slowly and turns out, say, only 19 pieces, then, instead of receiving 15 cents per piece he gets only 12 cents per piece, making his pay for the day $12 \times 19 = \$2.28$, instead of $3 per day.

If he succeeds in finishing 20 pieces, some of which are imperfect, then he should receive a still lower rate of pay, say 10 cents or 5 cents per piece, according to circumstances, making his pay for the day $2, or only $1, instead of $3.

It will be observed that this style of piece-work is directly the opposite of the ordinary plan. To make the difference between the two methods more clear: Supposing under the ordinary system of piece-work that the workman has been turning out 16 pieces per day, and has received 15 cents per piece; then his day's wages would be $15 \times 16 = \$2.40$. Through extra exertion he succeeds in increasing his output to 20 pieces per day, and thereby increases his pay to $15 \times 20 = \$3$. The employer, under the old system, however, concludes that $3 is too much for the man to earn per day, since other men are only getting from $2.25 to $2.50, and therefore cuts the price from 15 cents per piece to 12 cents, and the man finds himself working at a more rapid pace and yet earning only the same old wages, $12 \times 20 = \$2.40$ per

day. What wonder that men do not care to repeat this performance many times?

53. Whether coöperation, the differential plan, or some other form of piece-work be chosen in connection with elementary rate-fixing, as the best method of working, there are certain fundamental facts and principles which must be recognized and incorporated in any system of management before true and lasting success can be attained; and most of these facts and principles will be found to be not far removed from what the strictest moralists would call justice.

54. The most important of these facts is, that MEN WILL NOT DO AN EXTRAORDINARY DAY'S WORK FOR AN ORDINARY DAY'S PAY; and any attempt on the part of employers to get the best work out of their men and give them the standard wages paid by their neighbors will surely be, and ought to be, doomed to failure.

55. Justice, however, not only demands for the workman an increased reward for a large day's work, but should compel him to suffer an appropriate loss in case his work falls off either in quantity or quality. It is quite as important that the deductions for bad work should be just, and graded in proportion to the shortcomings of the workman, as that the reward should be proportional to the work done.

The fear of being discharged, which is practically the only penalty applied in many establishments, is entirely inadequate to producing the best quantity and quality of work; since the workmen find that they can take many liberties before the management makes up its mind to apply this extreme penalty.

56. It is clear that the differential rate satisfies automatically, as it were, the above condition of properly graded rewards and deductions. Whenever a workman works for a day (or even a shorter period) at his maximum, he receives under this system unusually high wages; but when he falls off either in quantity or quality from the highest rate of efficiency his pay falls below even the ordinary.

57. The lower differential rate should be fixed at a figure which will allow the workman to earn scarcely an ordinary day's pay when he falls off from his maximum pace, so as to give him every inducement to work hard and well.

58. The exact percentage beyond the usual standard which must be paid to induce men to work to their maximum varies with different trades and with different sections of the country, And there are places in the United States where the men (generally speaking) are so lazy and demoralized that no sufficient inducement can be offered to make them do a full day's work.

59. It is not, however, sufficient that each workman's ambition should be aroused by the prospect of larger pay at the end of even a comparatively short period of time. The stimulus to maximum exertion should be a daily one.

This involves such vigorous and rapid inspection and returns as to enable each workman in most cases to know each day the exact result of his previous day's work—*i. e.*, whether he has succeeded in earning his maximum pay, and exactly what his losses are for care-

less or defective work. Two-thirds of the moral effect, either of a reward or penalty, is lost by even a short postponement.

60. It will again be noted that the differential rate system forces this condition both upon the management and the workmen, since the men while working under it are above all anxious to know at the earliest possible minute whether they have earned their high rate or not. And it is equally important for the management to know whether the work has been properly done.

61. As far as possible each man's work should be inspected and measured separately, and his pay and losses should depend upon his individual efforts alone. It is, of course, a necessity that much of the work of manufacturing—such, for instance, as running roll-trains, hammers, or paper machines—should be done by gangs of men who coöperate to turn out a common product, and that each gang of men should be paid a definite price for the work turned out, just as if they were a single man.

In the distribution of the earnings of a gang among its members, the percentage which each man receives should, however, depend not only upon the kind of work which each man performs, but upon the accuracy and energy with which he fills his position.

In this way the personal ambition of each of a gang of men may be given its proper scope.

62. Again, we find the differential rate acting as a most powerful lever to force each man in a gang of workmen to do his best; since if, through the careless-

ness or laziness of any one man, the gang fails to earn its high rate, the drone will surely be obliged by his companions to do his best the next time or else get out.

63. A great advantage of the differential rate system is that it quickly drives away all inferior workmen and attracts the men best suited to the class of work to which it is applied, since none but really good men can work fast enough and accurately enough to earn the high rate; and the low rate should be made so small as to be unattractive even to an inferior man.

64. If for no other reason that it secures to an establishment a quick and active set of workmen, the differential rate is a valuable aid, since men are largely creatures of habit, and if the piece-workers of a place are forced to move quickly and work hard the day-workers soon get into the same way, and the whole shop takes on a more rapid pace.

65. The greatest advantage, however, of the differential rate for piece-work, in connection with a proper rate-fixing department, is that together they produce the proper mental attitude on the part of the men and the management toward each other. In place of the indolence and indifference which characterize the workmen of many day-work establishments and to a considerable extent also their employers, and in place of the constant watchfulness, suspicion, and even antagonism with which too frequently the men and the management regard each other under the ordinary piece-work plan, both sides soon appreciate the fact that with the differential rate it is their common interest to coöperate to the

fullest extent, and to devote every energy to turning out daily the largest possible output. This common interest quickly replaces antagonism and establishes a most friendly feeling.

66. Of the two devices for increasing the output of a shop, the differential rate and the scientific rate-fixing department, the latter is by far the more important. The differential rate is invaluable at the start as a means of convincing men that the management is in earnest in its intention of paying a premium for hard work, and it at all times furnishes the best means of maintaining the top notch of production; but when, through its application, the men and the management have come to appreciate the mutual benefit of harmonious coöperation and respect for each other's rights, it ceases to be an absolute necessity. On the other hand, the rate-fixing department, for an establishment doing a large variety of work, becomes absolutely indispensable. The longer it is in operation the more necessary it becomes.

67. Practically, the greatest need felt in an establishment wishing to start a rate-fixing department is the lack of data as to the proper rate of speed at which work should be done.

There are hundreds of operations which are common to most large establishments; yet each concern studies the speed problem for itself, and days of labor are wasted in what should be settled once for all and recorded in a form which is available to all manufacturers.

68. What is needed is a hand-book on the speed with which work can be done, similar to the elementary en-

gineering hand-books. And the writer ventures to predict that such a book will, before long, be forthcoming. Such a book should describe the best method of making, recording, tabulating, and indexing time-observations, since much time and effort are wasted by the adoption of inferior methods.

69. The term "rate-fixing department," has rather a formidable sound. In fact, however, that department should consist in most establishments of one man, who in many cases need give only a part of his time to the work.

70. When the manufacturing operations are uniform in character and repeat themselves day after day—as, for instance, in paper or pulp mills—the whole work of the place can be put upon piece-work in a comparatively short time; and when once proper rates are fixed the rate-fixing department can be dispensed with, at any rate until some new line of manufacture is taken up.

71. The system of differential rates was first applied by the writer to a part of the work in the machine shop of the Midvale Steel Company, in 1884. Its effect in increasing and then maintaining the output of each machine to which it was applied was almost immediate, and so remarkable that it soon came into high favor with both the men and the management. It was gradually applied to a great part of the work of the establishment, with the result, in combination with the rate-fixing department, of doubling and in many cases trebling the output, and at the same time increasing instead of diminishing the accuracy of the work.

72. In some cases it was applied by the rate-fixing department without an elementary analysis of the time required to do the work, simply offering a higher price per piece providing the maximum output before attained was increased to a given extent. Even this system met with success although it is by no means correct, since there is no certainty that the reward is in just proportion to the efforts of the workmen.

73. In cases where large and expensive machines are used, such as paper machines, steam hammers, or rolling mills, in which a large output is dependent upon the severe manual labor as well as the skill of the workmen (while the chief cost of production lies in the expense of running the machines rather than in the wages paid), it has been found of great advantage to establish two or three differential rates, offering a higher and higher price per piece or per ton as the maximum possible output is approached.

74. As before stated, not the least of the benefits of elementary rate-fixing are the indirect results.

The careful study of the capabilities of the machines and the analysis of the speeds at which they must run, before differential rates can be fixed which will insure their maximum output, almost invariably result in first indicating and then correcting the defects in their design and in the method of running and caring for them.

75. In the case of the Midvale Steel Company, to which I have already referred, the machine shop was equipped with standard tools furnished by the best makers, and the study of these machines, such as lathes,

planers, boring mills, etc., which was made in fixing rates, developed the fact that they were none of them designed and speeded so as to cut steel to the best advantage. As a result, this company has demanded alterations from the standard in almost every machine which they have bought during the past eight years. They have themselves been obliged to superintend the design of many special tools which would not have been thought of had it not been for elementary rate-fixing.

76. But what is perhaps of more importance still, the rate-fixing department has shown the necessity of carefully systematizing all of the small details in the running of each shop, such as the care of belting, the proper shape for cutting tools, and the dressing, grinding, and issuing same, oiling machines, issuing orders for work, obtaining accurate labor and material returns, and a host of other minor methods and processes. These details, which are usually regarded as of comparatively small importance, and many of which are left to the individual judgment of the foreman and workmen, are shown by the rate-fixing department to be of paramount importance in obtaining the maximum output, and to require the most careful and systematic study and attention in order to insure uniformity and a fair and equal chance for each workman. Without this preliminary study and systematizing of details it is impossible to apply successfully the differential rate in most establishments.

77. As before stated, the success of this system of piece-work depends fundamentally upon the possibility of materially increasing the output per man and per

machine, providing the proper man be found for each job and the proper incentive be offered to him.

78. As an illustration of the difference between what ought to be done by a workman well suited to his job, and what is generally done, I will mention a single class of work, performed in almost every establishment in the country. In shovelling coal from a car over the side on to a pile one man should unload forty tons per day, and keep it up year in and year out, and thrive under it.

With this knowledge of the possibilities I have never failed to find men who were glad to work at this speed for from four and a half to five cents per ton. The average speed for unloading coal in most places, however, is nearer fifteen than forty tons per day. In securing the above rate of speed it must be clearly understood that the problem is not how to force men to work harder or longer hours than their health will permanently allow, but rather first to select among the laborers which are to be found in every community the men who are physically able to work permanently at that job and at the speed mentioned without damage to their health, and who are mentally sufficiently inert to be satisfied with the monotony of the work, and then to offer them such inducements as will make them happy and contented in doing so.

79. The first case in which a differential rate was applied furnishes a good illustration of what can be accomplished by it.

A standard steel forging, many thousands of which are used each year, had for several years been turned at

the rate of from four to five per day under the ordinary system of piece-work, 50 cents per piece being the price paid for the work. After analyzing the job and determining the shortest time required to do each of the elementary operations of which it was composed, and then summing up the total, the writer became convinced that it was possible to turn ten pieces a day. To finish the forgings at this rate, however, the machinists were obliged to work at their maximum pace from morning to night, and the lathes were run as fast as the tools would allow, and under a heavy feed.

It will be appreciated that this was a big day's work, both for men and machines, when it is understood that it involved removing, with a single 16-inch lathe having two saddles, an average of more than 800 pounds of steel chips in ten hours. In place of the 50-cent rate that they had been paid before, they were given 35 cents per piece when they turned them at the speed of 10 per day, and when they produced less than 10 they received only 25 cents per piece.

80. It took considerable trouble to induce the men to turn at this high speed, since they did not at first fully appreciate that it was the intention of the firm to allow them to earn permanently at the rate of $3.50 per day. But from the day they first turned 10 pieces to the present time, a period of more than ten years, the men who understood their work have scarcely failed a single day to turn at this rate. Throughout that time, until the beginning of the recent fall in the scale of wages throughout the country, the rate was not cut.

81. During this whole period the competitors of the company never succeeded in averaging over half of this production per lathe, although they knew and even saw what was being done at Midvale. They, however, did not allow their men to earn over from $2 to $2.50 per day, and so never even approached the maximum output.

82. The following table will show the economy of paying high wages under the differential rate in doing the above job.

COST OF PRODUCTION PER LATHE PER DAY.

| *Ordinary system of piece-work.* | | *Differential rate system.* | |
|---|---|---|---|
| Man's wages . . . . . | $2 50 | Man's wages . . . . . | $3 50 |
| Machine cost . . . . . | 3 37 | Machine cost . . . . . | 3 37 |
| Total cost per day . . | $5 87 | Total cost per day . . . | $6 87 |
| 5 pieces produced. | | 10 pieces produced. | |
| Cost per piece . . . . . | $1 17 | Cost per piece . . . . . | $0 69 |

The above result was mostly, though not entirely, due to the differential rate. The superior system of managing all of the small details of the shop counted for considerable.

83. There has never been a strike by men working under differential rates, although these rates have been applied at the Midvale Steel Works for the past ten years, and the steel business has proved during this period the most fruitful field for labor organizations and strikes. And this notwithstanding the Midvale Company has never prevented its men from joining any labor organization. All of the best men in the company saw clearly that the success of a labor organization

meant the lowering of their wages in order that the inferior men might earn more, and of course could not be persuaded to join.

84. I attribute a great part of this success in avoiding strikes to the high wages which the best men were able to earn with the differential rates, and to the pleasant feeling fostered by this system; but this is by no means the whole cause. It has for years been the policy of that company to stimulate the personal ambition of every man in their employ, by promoting them either in wages or position whenever they deserved it and the opportunity came.

A careful record has been kept of each man's good points as well as his shortcomings, and one of the principal duties of each foreman was to make this careful study of his men, so that substantial justice could be done to each. When men throughout an establishment are paid varying rates of day-work wages according to their individual worth, some being above and some below the average, it cannot be for the interest of those receiving high pay to join a union with the cheap men.

85. No system of management, however good, should be applied in a wooden way. The proper personal relations should always be maintained between the employers and men; and even the prejudices of the workmen should be considered in dealing with them.

The employer who goes through his works with kid gloves on, and is never known to dirty his hands or clothes, and who either talks to his men in a condescend-

ing or patronizing way, or else not at all, has no chance whatever of ascertaining their real thoughts or feelings.

86. Above all it is desirable that men should be talked to on their own level by those who are over them.

Each man should be encouraged to discuss any trouble which he may have, either in the works or outside, with those over him. Men would far rather even be blamed by their bosses, especially if the "tearing out" has a touch of human nature and feeling in it, than to be passed by day after day without a word and with no more notice than if they were part of the machinery.

The opportunity which each man should have of airing his mind freely and having it out with his employers, is a safety-valve; and if the superintendents are reasonable men, and listen to and treat with respect what their men have to say, there is absolutely no reason for labor unions and strikes.

87. It is not the large charities (however generous they may be) that are needed or appreciated by workmen, such as the founding of libraries and starting workingmen's clubs, so much as small acts of personal kindness and sympathy, which establish a bond of friendly feeling between them and their employers.

88. The moral effect of the writer's system on the men is marked. The feeling that substantial justice is being done them renders them on the whole much more manly, straightforward, and truthful. They work more cheerfully, and are more obliging to one another and their employers. They are not soured, as under the old system, by brooding over the injustice done them; and

their spare minutes are not spent to the same extent in criticising their employers.

A noted French engineer and steel manufacturer, who recently spent several weeks in the works of the Midvale Company in introducing a new branch of manufacture, stated before leaving that the one thing which had impressed him as most unusual and remarkable about the place was the fact that not only the foremen but the workmen were expected to and did in the main tell the truth in case of any blunder or carelessness, even when they had to suffer from it themselves.

89. From what the writer has said he is afraid that many readers may gain the impression that he regards elementary rate-fixing and the differential rate as a sort of panacea for all human ills.

This is, however, far from the case. While he regards the possibilities of these methods as great, he is of the opinion, on the contrary, that this system of management will be adopted by but few establishments, in the near future at least, since its really successful application not only involves a thorough organization but requires the machinery and tools throughout the place to be kept in such good repair that it will be possible for the workmen each day to produce their maximum output. But few manufacturers will care to go to this trouble until they are forced to.

90. It is his opinion that the most successful manufacturers, those who are always ready to adopt the best machinery and methods when they see them, will gradually avail themselves of the benefits of scientific

rate-fixing; and that competition will compel the others to follow slowly in the same direction.

91. Even if all of the manufacturers in the country who are competing in the same line of business were to adopt these methods, they could still well afford to pay the high rate of wages demanded by the differential rate and necessary to induce men to work fast, since it is a well recognized fact the world over, that the highest-priced labor, providing it is proportionately productive, is the cheapest; and the low cost at which they could produce their goods would enable them to sell in foreign markets and still pay high wages.

92. The writer is far from taking the view held by many manufacturers that labor unions are an almost unmitigated detriment to those who join them, as well as to employers and the general public.

The labor unions—particularly the trades unions of England—have rendered a great service, not only to their members but to the world, in shortening the hours of labor and in modifying the hardships and improving the conditions of wage-workers.

In the writer's judgment the system of treating with labor unions would seem to occupy a middle position among the various methods of adjusting the relations between employers and men.

When employers herd their men together in classes, pay all of each class the same wages, and offer none of them any inducements to work harder or do better than the average, the only remedy for the men lies in combination; and frequently the only possible answer to encroachments on the part of their employers is a strike.

This state of affairs is far from satisfactory to either employers or men, and the writer believes the system of regulating the wages and conditions of employment of whole classes of men by conference and agreement between the leaders, unions, and manufacturers to be vastly inferior, both in its moral effect on the men and on the material interests of both parties, to the plan of stimulating each workman's ambition by paying him according to his individual worth, and without limiting him to the rate of work or pay of the average of his class.

93. The level of the great mass of the world's labor has been, and must continue to be, regulated by causes so many and so complex as to be at best but dimly recognized.

The utmost effect of any system, whether of management, social combination, or legislation, can be but to raise a small ripple or wave of prosperity above the surrounding level, and the greatest hope of the writer is that here and there a few workmen, with their employers, may be helped through this system toward the crest of the wave.